# Detailed Examination of the Flows of Municipal Solid Waste Through Three EPA Region 9 States (CA, HI, and NV) [1]


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**A Detailed Examination of the Flows of Municipal Solid Waste through Three EPA Region 9 States**

# Executive Summary

This report presents the results of in-depth research on the waste flows of three participating[2] EPA Region 9 States: California, Nevada, and Hawaii (Arizona was unable to provide enough information to participate in this study). The research provides the foundation for a new, online, geographical database of Municipal Solid Waste (MSW) management in the U.S. (www.wastemap.us). A critical analysis of publicly available reports and publications and of data provided by state officials were used to derive adjusted MSW flows using EPA's MSW definition for the three examined states. EPA's definition differs from that of individual states' because EPA does not include materials such as construction and demolition debris, biosolids, special waste, household hazardous waste, alternative daily cover, and auto body scrap.

**Results show that Region 9 states recycle over 37 percent of their MSW stream, send 2.5 percent to Waste to Energy (WTE) facilities, and landfill the remainder – just over 60 percent.** These data are summarized in Figure 1. Figure 2 shows overall waste management trends for the three states.

As the charts plainly show, landfilling is still the waste treatment option for the majority of MSW produced in the region, despite significant efforts at recycling. But there are major differences among the three states examined. California and Nevada are notable for their reliance on landfilling for all non-recycled materials, while Hawaii – and Honolulu in particular – stands out due to its heavy use of waste to energy (WTE) to handle non-recycled materials. Future studies will examine the environmental and energy implications of these dichotomies.

Additional analysis of organics recycling showed that green waste – and food scraps in particular – could have a significant impact on diversion success in California. In Honolulu, yard waste is the most efficiently recovered commodity. Only 19 percent of paper is recovered, however, and this highly marketable commodity would therefore be a good target for increased overall diversion.

A major conclusion that was drawn from this research is there is quite a bit of MSW data available, but it is dispersed among various government officials and agencies as well as private companies. A relatively simple coordinating effort goes a long way towards identifying waste management trends and targeting materials management priorities. This is the motivation behind the creation of the MSW database.

[2] These states provided data and had one or more state or local officials in contact with us throughout this study.

Another important conclusion drawn from this study is that ***there is a tremendous opportunity for convergence between the U.S. EPA and the BioCycle/Columbia studies of waste management in the U.S.*** EPA has excellent data on recycling of MSW, mostly due to its close relation to industry organizations. The BioCycle/Columbia team has developed good relations with a robust network of state waste managers who have direct access to MSW generation and disposal data, as well as Material Recovery Facility (MRF) and compost facility operator contacts. These two strengths could be combined to produce a more reliable overall set of MSW management figures to support improved materials management.

Finally, the 37 percent recycling rate surpasses the goal of 35 percent recycling by 2008 set by the National EPA's Resource Conservation Challenge. If included, Arizona would only have to recycle at a rate of 16 percent to maintain the overall Region 9 recycling rate at 35 percent.

**Figure 1 Recycling, WTE, and Landfilling Rates for Region 9 States**

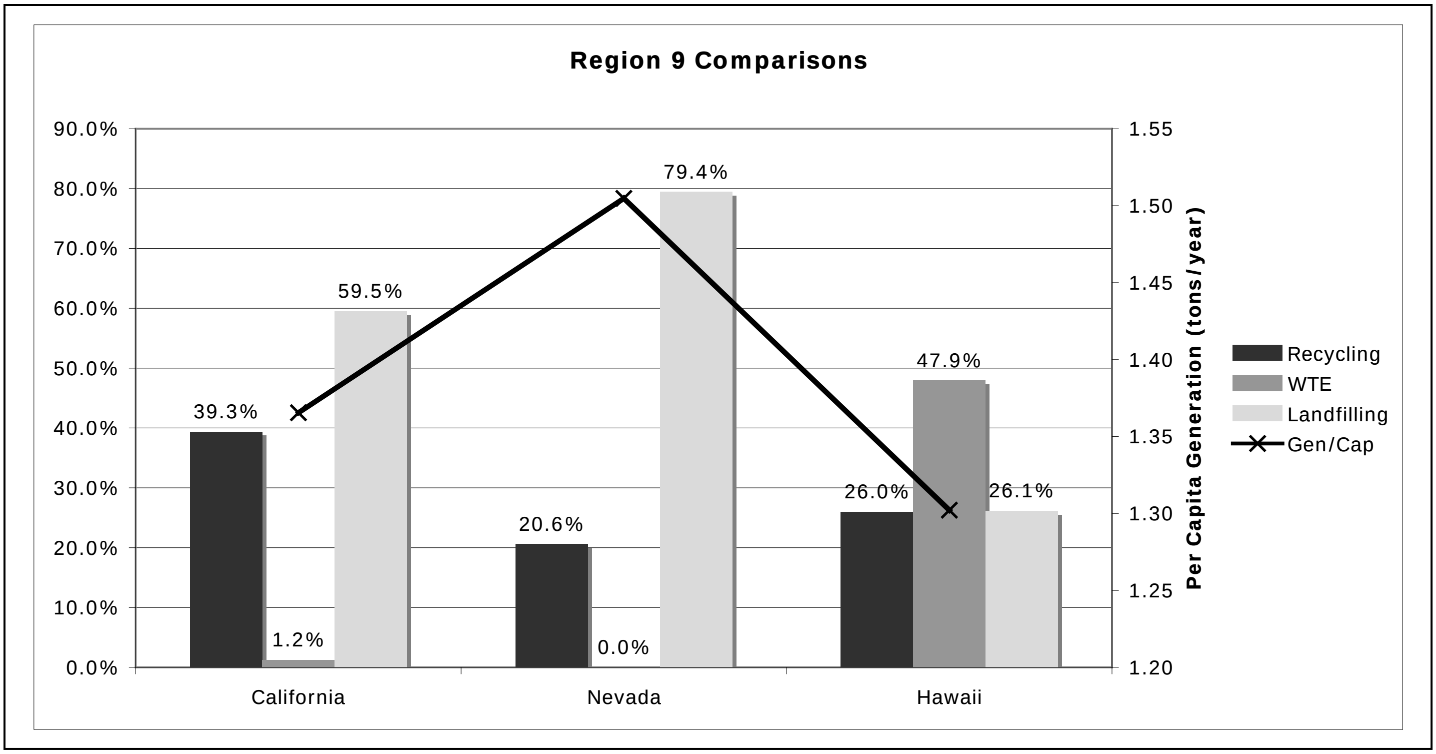
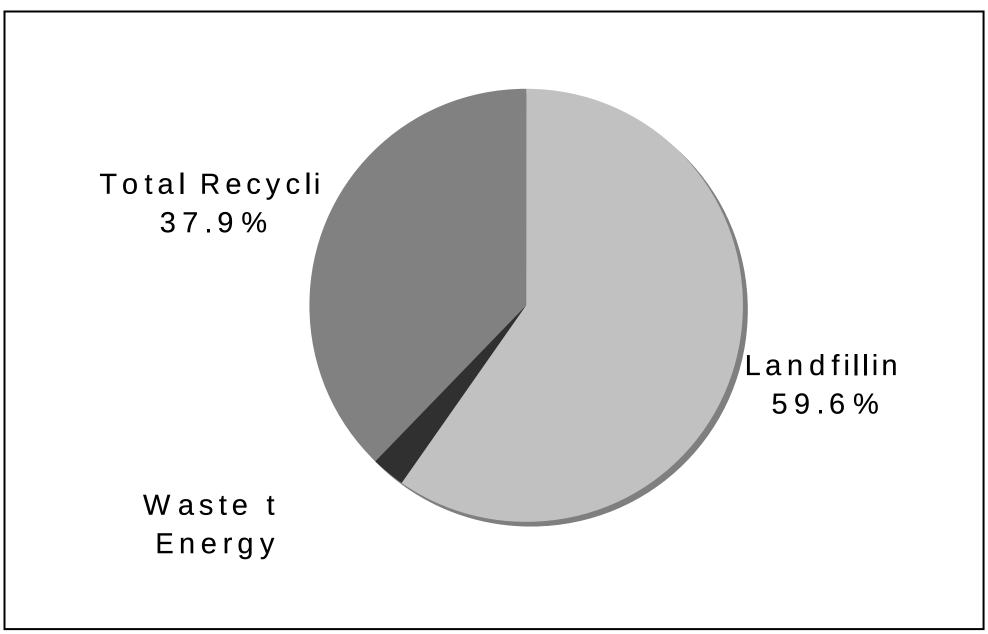



**Figure 2 Average disposition of MSW in California, Nevada and Hawaii**



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## Methodology: Data Gathering for EPA Region 9

There are myriad sources of municipal solid waste (MSW) data but – depending on the locality or region one wishes to assess – much of this information can be extremely difficult to find. Furthermore, once this information is located it can be very hard to decipher. This is due mostly to inconsistencies in reporting methods across regions and, often, a lack of financial resources on the part of the data collectors.

It is important to make these data – which are vital to the environmentally responsible management of resources – easier to obtain. The primary objective of the municipal solid waste database (MSW-DB) developed during this study at Columbia University was to provide a central storehouse of reliable and readily available MSW data for the general public to use.

Because so many data already exist in published form, the MSW-DB is designed to utilize, as much as possible, preexisting information. The process of aggregating and organizing this information in one location identifies data discrepancies and gaps and is likely to indicate future research needs in terms of data acquisition and reporting.

The steps taken in the creation of the MSW-DB are as follows:

1. Aggregate waste data reports published by local and state agencies to arrive at statewide estimates of waste generation, recycling, and disposal tonnages. Draw conclusions for further action (e.g., delineate needs for further data research).

2. Perform a materials flow analysis (MFA) for all four Region 9 states using the *indirect* method, using production and other published data. The indirect method is described in *The Practical Handbook* and variations of it are widely used in the waste data industry (and also by the US EPA) [1].

3. Perform as-needed facilities level research. The focal points here are likely to be those sectors that traditionally suffer from lack of transparent data, namely material recovery facilities (MRFs) and exporters of waste scrap materials.[3]

The first step in cross-referencing municipal solid waste MSW data from various states is to eliminate – to the extent possible – apparent inconsistencies arising from different methods of collection and reporting. The easiest way to do this is by following the EPA definitions.

[3] Due to time constraints, this has only been performed on a preliminary basis for this project. The results are not included in this report, but can be summarized by the authors upon request.

Please note: Results from this study have been published in the Columbia University new online waste management database at www.wastemap.us.

## EPA Municipal Solid Waste Definitions

In 1997, the US EPA published a large document with advice for state and local governments on measuring recycling in their jurisdictions [2]. The goal of this document was to help waste management authorities in different jurisdictions to publish standardized recycling data that could be compared across regions. The report was based on the expert advice of waste industry and government officials across the US and it was hoped that stakeholders would adopt these standards, thus allowing for easier top-down planning of waste systems, where appropriate. Though the standards have not been adopted universally, they are generally accepted and were certainly useful for the purposes of this study.

The EPA divided the definitions into two main parts – a "scope of materials" and a "scope of activities" (See Figure  and Figure ).

**Figure 3 EPA MSW Definitions - Scope of Materials (Adapted from Measuring Recycling)**

| MATERIAL | WHAT IS MSW | WHAT IS NOT MSW |
|---|---|---|
| Food Scraps | Uneaten food and food preparation wastes from residences and commercial establishments (restaurants, supermarkets, and produce stands), institutional sources (school cafeterias), and industrial sources (employee lunchrooms). | Food processing waste from agricultural and industrial operations. |
| Glass Containers | Containers; packaging; and glass found in appliances, furniture, and consumer electronics. | Glass from transportation equipment (automobiles) and construction and demolition (C&D) debris (windows). |
| Lead-Acid Batteries | Batteries from automobiles, trucks, and motorcycles. | Batteries from aircraft, military vehicles, boats, and heavy-duty trucks and tractors. |
| Tin/Steel Cans and Other Ferrous Metals | Tin-coated steel cans; strapping; and ferrous metals from appliances (refrigerators), consumer electronics, and furniture. | Ferrous metals from C&D debris and transportation equipment. |
| Aluminum Cans and Other Nonferrous Metals | Aluminum cans; nonferrous metals from appliances, furniture, and consumer electronics; and other aluminum items (foil and lids from bimetal cans). | Nonferrous metals from industrial applications and C&D debris (aluminum siding, wiring, and piping). |
| Paper | Old corrugated containers; old magazines; old newspapers; office papers; telephone directories; and other paper products including books, third-class mail, commercial printing, paper towels, and paper plates and cups. | Paper manufacturing waste (mill broke) and converting scrap not recovered for recycling. |
| Plastic | Containers; packaging; bags and wraps; and plastics found in appliances, furniture, and sporting and recreational equipment. | Plastics from transportation equipment. |
| Textiles | Fiber from apparel, furniture, linens (sheets and towels), carpets and rugs, and footwear. | Textile waste generated during manufacturing processes (mill scrap) and C&D projects. |
| Tires | Tires from automobiles and trucks. | Tires from motorcycles4, buses, and heavy farm and construction equipment. |
| Wood | Pallets; crates; barrels; and wood found in furniture and consumer electronics. | Wood from C&D debris (lumber and tree stumps) and industrial process waste (shavings and sawdust). |
| Yard Trimmings | Grass, leaves, brush and branches, and tree stumps. | Yard trimmings from C&D debris. |
| Other | Household hazardous waste (HHW), oil filters, fluorescent tubes, mattresses, and consumer electronics. | Abatement debris, agricultural waste, combustion ash, C&D debris, industrial process waste, medical waste, mining waste, municipal sewage and industrial sludges, natural disaster debris, used motor oil, oil and gas waste, and preconsumer waste. |

**Figure 4 EPA MSW Definitions - Scope of Activities (Adapted from Measuring Recycling)**

| RECYCLABLE MATERIAL | WHAT COUNTS AS RECYCLING | WHAT DOES NOT COUNT AS RECYCLING |
|---|---|---|
| Food Scraps | Composting of food scraps from grocery stores, restaurants, cafeterias, lunchrooms, and private residences, and the use of food scraps to feed farm animals. | Backyard (onsite) composting of food scraps, and the use of food items for human consumption (food banks). |
| Glass | Recycling of container and packaging glass (beverage and food containers), and recycling of glass found in furniture, appliances, and consumer electronics into new glass products such as containers, packaging, construction materials (aggregate), or fiberglass (insulation). | Recycling of glass found in transportation equipment and construction and demolition (C&D) debris, recycling of preconsumer glass or glass from industrial processes, and reuse of refillable glass bottles. |
| Lead-Acid Batteries | Recycling of lead-acid batteries found in cars, trucks, or motorcycles into new plastic and lead products. | Recycling of lead-acid batteries used in large equipment, aircraft, military vehicles, boats, heavy-duty trucks and tractors, and industrial applications. |
| Metals | Recycling of aluminum and tin/steel cans, and recycling of metals found in appliances and packaging into new metal products. | Reuse of metal containers, packaging, furniture, or consumer electronics, and recycling of metals found in transportation equipment (autobodies) and C&D debris. |
| Paper | Recycling of paper products (old newspapers and office papers) into new paper products (tissue, paperboard, hydromulch, animal bedding, or insulation materials). | Reuse of paper products, recycling of preconsumer or manufacturing waste (trimmings, mill broke, print overruns, and overissue publications), and combustion of paper for energy recovery. |
| Plastic | Recycling of plastic products (containers, bags, and wraps), and recycling of plastic from furniture and consumer electronics into new plastic products (fiber fill and plastic lumber). | Reuse of plastic products (storage containers and sporting equipment), recycling of preconsumer plastic waste or industrial process waste, and combustion of plastics for energy recovery. |
| Textiles | Recycling of textiles into wiper rags, and recycling of apparel and carpet fiber into new products such as linen paper or carpet padding. | Reuse of apparel. |
| Tires | Recycling of automobile and truck tires into new products containing rubber (trash cans, storage containers, and rubberized asphalt), and use of whole tires for playground and reef construction. | Recycling of tires from motorcycles, buses, and heavy farm and construction equipment, retreading of tires, and combustion of tire chips for energy recovery. |
| Wood | Recycling of wood products (pallets and crates) into mulch, compost, or similar uses. | Repair and reuse of pallets, combustion of wood for energy recovery, recycling of industrial process waste (wood shavings or sawdust), and recycling of wood from C&D debris. |
| Yard Trimmings | Offsite recycling of grass, leaves, brush or branches, and tree stumps into compost, mulch, or similar uses; and landspreading of leaves. | Mulching of tree stumps from C&D debris, backyard (onsite) composting, grasscycling, landspreading of leaves, and combustion of yard trimmings for energy recovery. |
| Other | Household hazardous waste (HHW), oil filters, fluorescent tubes, mattresses, circuit boards, and consumer electronics. | Recycling of used oil, C&D debris (asphalt, concrete, and natural disaster debris), transportation equipment (autobodies), municipal sewage sludge, and agricultural, industrial, mining, and food processing waste. |

## *Waste Characterization*

The three states examined in this study perform waste characterization studies at different times, making it difficult to determine the average composition of a ton of MSW in a given year. The most recent comprehensive characterization was performed in the state of California by CIWMB in 2004. The results will be used as a reference – even for states other than California - throughout this study. Also, it has been shown elsewhere [3] that the EPA/Franklin Waste Characterization provides a reasonably accurate picture of MSW composition. It will therefore also be used in this study.

## California Waste Data Analysis

Because California has the most comprehensive set of MSW reports available, it was decided to start with this state. What follows is a narrative of the journey through the vast storehouse of online MSW data and reports provided by the California Integrated Waste Management Board (CIWMB).

### *Aggregation and Interpretation of California Data*

The CIWMB is the largest, most comprehensive and complex organization of its kind in the United States. In the Governor's 2007-08 proposed budget, over $200 million were allotted to "waste reduction and management" activities. This works out to roughly $5.50 per capita [4]. More than three-quarters of non-administrative expenditures are directly related to waste reduction and recycling. The source of this funding is provided by landfill fees that are assessed for each ton of waste sent to landfills in California [5].

This is often a source of envy for neighboring states, which appear to be considerably less well funded. This is only partially the case. While some of the per ton fees are directly applicable to diversion activities, the $200 million funds a wide range of waste-related activities, including "the Waste Management Board for oversight of jurisdiction (city, county or region) and state agency waste management planning and diversion program implementation activities; market development activities; and oversight of local government enforcement of requirements to ensure solid waste handling and disposal facilities protect public health and safety and the environment." [6]

While CIWMB publishes vast quantities of data – both in online databases and published reports – it is sometimes difficult to track the source of the information. This is particularly the case with recycling tonnages. CIWMB uses a complicated formula in which a base-year waste characterization is applied in combination with disposal tonnages – which are meticulously tracked by the board since their income derives from landfilling fees – to arrive at an estimated recycling tonnage. Generally speaking, then, disposal tonnages (LF + WTE) are measurement-based while recycling tonnages are estimated.

However, due to the breadth of the research conducted and funded by CIWMB, it is possible to combine the California waste information with the findings of several of the published reports to arrive at a reasonable calculation of waste flows in the state.

CIWMB reported that 42,089,545 tons of solid wastes were landfilled in the state in 2005 [7]. In the previous year, the Board released a comprehensive report that used detailed sampling procedures at disposal facilities across the state to statistically determine the composition of California's solid waste [8]. Using that report and the EPA definitions, it was possible to estimate the non-MSW tons landfilled in the state (Figure 3). WTE tonnages [4] were derived from the EEC/BioCycle 2005 "State of Garbage in America" survey and are also listed in Table 1. [9]

**Table 1 2005 Derived Tonnages of MSW Disposal in California[5]**

| **California 2005 MSW Data** | | **Tons** |
|---|---|---|
| **Disposal (unadjusted)** | | **42,090,000** |
| | Less construction & demolition (C&D) | 9,133,000 |
| | Less household hazardous (HH) | 126,000 |
| | less special waste | 2,904,000 |
| | **Total MSW Disposal** | **29,926,000** |
| | **MSW to Landfill** | **29,335,000** |
| | **MSW to WTE** | **591,000** |

In 2006, Cascadia Consulting Group and R.W. Beck released a CIWMB-funded report [10] characterizing the residuals from materials recovery facilities (MRF) in California. A total of 390 samples were taken from a representative cross-section of MRFs across the state. Using the data reported from these activities, it was possible to back-calculate recycling tonnages that passed through the MRFs.

To incorporate the composting and mulching of organic wastes into this assessment of recycled tonnage, a CIWMB-funded report on California's composting infrastructure was utilized [11]. This report was an attempt to quantify the amounts of organic waste being handled by compost and mulch producing facilities in California. The estimated recycling and organics processing tonnages are shown in Table 2.

[4] WTE tonnages were calculated as follows: MSW adjustments were made to California's raw disposal tons on a percentage basis – i.e. C&D, HHW, and special waste accounted for approximately 29 percent of the raw disposal tons. This percentage was applied to BioCycle's WTE tonnage to arrive at MSW WTE tonnage.

[5] Note: all tonnage totals are rounded to the nearest thousand to account for likely measurement errors by states.

**Table 2 2005 Derived Tonnages of MSW Recycled in California**

| | | |
|---|---|---|
| **Recycling** | | **Tons** |
| | Single stream MRFs | 3,547,000 |
| | Multi-stream MRFs | 598,000 |
| | Mixed waste MRFs | 1,566,000 |
| | **Total (MSW) MRF Rec.** | **5,712,000** |
| | Direct to Recycler Tons | 6,719,000 |
| | **Total MSW Recycling Tons** | **12,431,000** |
| **Organics processing** | | |
| | Composters | 4,730,000 |
| | Processors | 5,138,000 |
| | less alternate daily cover (ADC) | 2,100,000 |
| | less agricultural | 395,000 |
| | less waste water treatment plant residues (WWTP) | 395,000 |
| | **Total Organics Recycling** | **6,979,000** |
| **Total Recycling Tons** | | **19,409,000** |

The methodology used to estimate direct-to-recycler tonnage is as follows: The number of tons of paper recovered in the US in 2005 was 51 million tons. We contacted Governmental Advisory Associates to determine the amount of fiber going through US MRFs in 2005 (17.2 million tons) [12]. The difference is US "direct-to-recycler" fiber tons. We then multiplied this amount by California's share of US recycling tonnage, according to the BioCycle/Columbia State of Garbage report (20 percent) to arrive at California's share of US direct-to-recycler fibers of approximately 6.7 million tons. [6]

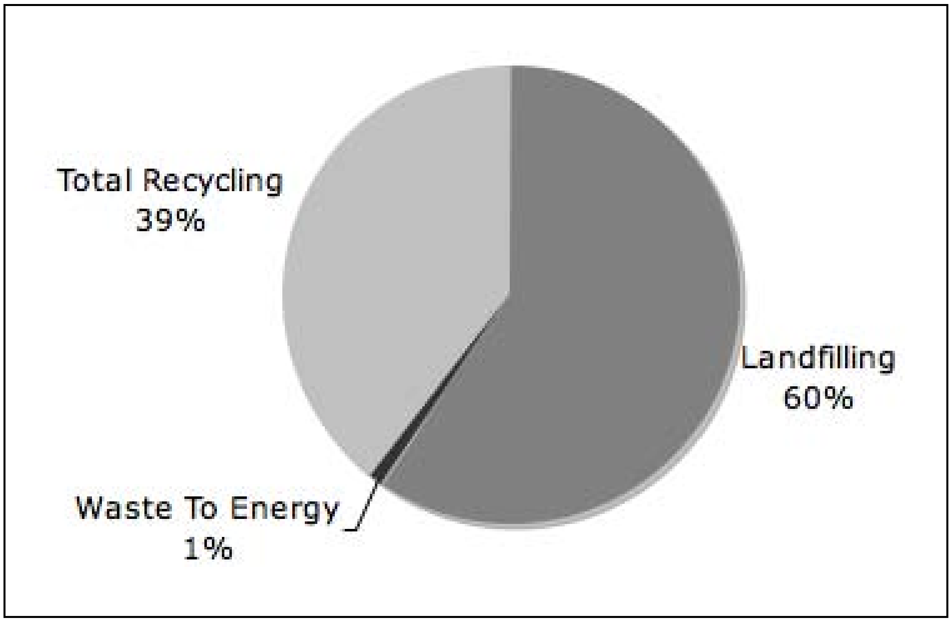
Putting all of this information together resulted in the estimate of California's recycling, WTE, and landfilling rates shown in Table 3.

**Table 3 2005 Derived Tonnages of Waste Generation and Disposition in California**

| | **Tons** | | **Percent** |
|---|---|---|---|
| Total California Recycling Tons | 19,409,000 | | 38.9% |
| Total MSW WTE | 591,000 | | 1.2% |
| Total MSW Landfilled | | 29,926,000 | 59.9% |
| **Total California MSW Generation** | **49,925,000** | | |
| **Per capita MSW Generation** | **1.38** | | |

[6] It is likely that other materials – particularly steel – also have "direct-to-recycler" tons, but we were unable to account for those materials in this study. These tons would be significantly less than paper, however.

**Figure 5 California MSW Management**




## *Comments on California Data*

It is necessary to note some of the possible reasons for the lower recycling rate calculated in this report, as compared to that reported by CIWMB. The first important consideration is that the widely cited "diversion rate" of CIWMB is different from the "recycling rate" that was calculated above. The CIWMB diversion rate is estimated using a complex set of economic and population indicators. These calculations are used to estimate a waste generation tonnage. The only "hard" numbers in the calculation are disposal tons that, as mentioned earlier, facilities are required to report to the State. In addition, CIWMB includes C&D generation and recycling in reported diversion rates as well as organics used for alternative daily cover, agricultural organics recycling, waste water treatment plant residues, special waste, and household hazardous waste.

We attempted to account for "direct-to-recycler" tonnages in our analysis, using the methodology described above. These are recycled materials that are collected, usually from businesses, and never pass through municipal facilities such as MRFs. Instead, they are brought directly to recycling facilities (such as paper mills) or brought to ports for export to other countries for reprocessing. We have been able to include estimates on the contribution of these materials to California's recycling rate.

## Nevada Waste Data Analysis

Nevada law requires the preparation and publication of a biennial report on the status of recycling in the state. This legislation more specifically calls for mandatory disposal facility tonnage reports, which appear to be accurately completed by all eligible facilities. The legislation also calls for reporting by recycling facilities, which has not been as successful, due largely to the limited resources of the municipal offices required to carry out the data reporting and compilation [13].

The following data are drawn mostly from a single, unpublished Nevada Bureau of Waste Management (BWM) report [14]. Additionally, there was consistent communication with BWM staff to validate data and secure supplementary information. We also established contact with Republic Waste Services, which manages Las Vegas area landfills and has a great deal of data on Nevada waste management [15].

An attempt was made to follow the same procedures used in the California data analysis. The lack of parallel companion reports, such as the MRF and compost facilities publications and, most importantly, a waste characterization study, made this task more difficult. Nevertheless, the data provided were sufficient for a reasonable estimate of Nevada waste flows (Table 4).

The biosolids[7] tonnages were calculated as follows: A US EPA report [16] on biosolids generation and disposal was used to estimate a US per capita biosolids generation rate. This was combined with census population numbers to estimate Nevada generation rates. Biosolids recycling tonnages, which are documented in the BWM report, were subtracted from this derived generation rate to arrive at biosolids tonnages disposed in landfills.

**Table 4 2005 Derived Tonnages of MSW Disposed in Nevada**

| **Nevada 2005 MSW Data** | | **Tons** |
|---|---|---|
| **Landfilling** | | **3,566,000** |
| | less C&D | 774,000 |
| | less biosolids | 404,000 |
| | **Total MSW landfilled** | **2,388,000** |
| | **Total disposal tons** | **2,388,000** |

Table 5 shows the data used to calculate recycling tons in Nevada. Automobile scrap and biosolids recycling tonnages were both detailed in the BWM report.

[7] Biosolids are the solid materials left after treating municipal wastewater. They are often used as fertilizer, and are not counted in the EPA MSW definition.

**Table 5 2005 Derived Tonnages of MSW Recycled in Nevada**

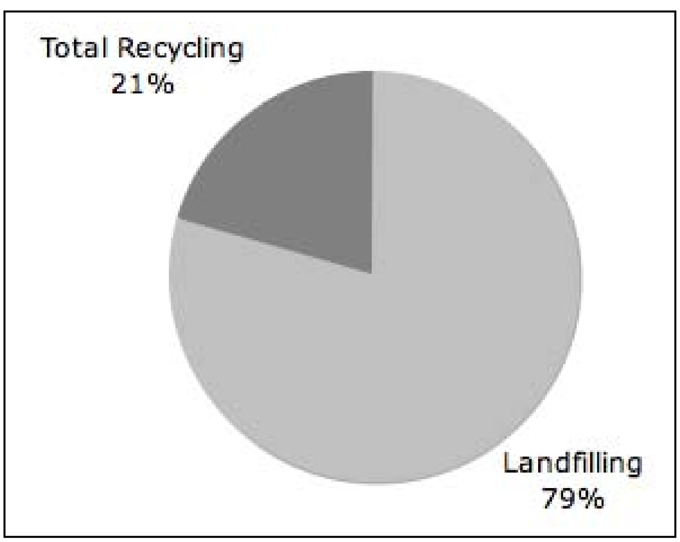
| **Nevada Recycling** | | **Tons** |
|---|---|---|
| Totals | | 968,000 |
| | less auto scrap | 243,000 |
| | less biosolids | 106,000 |
| | **Total MSW Recycled** | **619,000** |

Table 6 shows the aggregate tonnages and percentage breakdowns for MSW management in Nevada.

**Table 6 2005 Derived Total Tonnages Recycled and Landfilled in Nevada**

| | **Tons** | **Percent** |
|---|---|---|
| Total Nevada Recycling tons | 619,000 | 20.6% |
| Total MSW Landfilled | 2,388,000 | 79.4% |
| **Total Nevada MSW Generation** | **3,007,000** | |
| **Nevada per capita MSW Generation** | **1.50** | |

**Figure 6 Nevada MSW Management**



## Hawaii Waste Data Analysis

Hawaii presents some unique challenges due to its geography – as a group of islands, it is apparently more difficult to track the state's waste through a central authority. This project researched data from the state as well as from counties and municipalities.

Fortunately, much of Hawaii's population is concentrated in the Honolulu area on the island of Oahu – 905,000 people in 2005, or 71 percent of the statewide population [17]. Also, Honolulu keeps excellent and detailed records of waste handling on the island of Oahu.

Most of the remainder of Hawaii's population is concentrated on two islands – Maui (11 percent) and Hawaii (13 percent), bringing these three islands' share of the state's total population to 95 percent. The quality of Maui and Hawaii data is also high and allowed us to piece together a representative picture of most of the state's waste flow.

The methodology used to gather overall statewide data for Hawaii was as follows: Published reports were gathered from the major areas studied: Oahu, Hawaii, and Maui. Additionally, communications were established with representatives responsible for data collection in these jurisdictions. (The names of these participants can be found in the Acknowledgements section at the end of this report.) Finally, the data were normalized and agglomerated.

### *Honolulu/Oahu*

As mentioned above, Honolulu comprises over 70 percent of Hawaii's population. Solid waste data in Honolulu is managed by the Department of Environmental Services (DES) of the City & County of Honolulu. They maintain an informative website (www.opala.org) with yearly updates on waste data. This was a principal source of the data used in this report. It was particularly helpful that DES released the final report of their 2006 waste characterization study in the Summer of 2007 – this allowed for a fuller accounting of waste flows in Honolulu [18].

Because of the availability of the comprehensive waste characterization study, it was decided to use 2006 data for Honolulu; 2005 data was used for the rest of the examined states and municipalities in this study. The total MSW disposal (WTE + Landfilling) in 2006 was 940,187 tons. MSW recycling accounted for 297,000 tons, resulting in 1,237,000 tons of MSW generated overall [19].

A major adjustment had to be made in the category of "ferrous metals (including autos)" recycling. Scrap metal from the recovery of automobiles does not fall under the EPA definition of MSW and therefore was excluded. However, automobile scrap was not specifically reported in Hawaii, so we had to estimate this tonnage value[8]. The original amount of ferrous metals (including autos) diverted was reported to be 131,591 tons. The adjusted amount was estimated at only 13,146 tons.

Recycling adjustments are shown in Table 7. MSW disposal tonnages for Honolulu are shown in Table 8, while overall Honolulu totals are shown in Table 9.

**Table 7 Derived Tonnages of MSW Recycled in Honolulu**

| | | Tons |
|---|---|---|
| Recycling (unadjusted) | | **543,000** |
| | less auto scrap | 118,000 |
| | less C&D | 122,000 |
| | less biosolids | 6,000 |
| | **MSW Recycled** | **297,000** |

**Table 8 Derived Tonnages of MSW Disposal in Honolulu**

| | | Tons |
|---|---|---|
| Disposal | | 868,000 |
| | **MSW to WTE** | **756,000** |
| | **MSW Landfilling** | **113,000** |

**Table 9 Derived Tonnages of Waste Generation and Disposition in Honolulu**

| | Tons | | Percent |
|---|---|---|---|
| Total MSW Recycling Tons | 297,000 | | 25.5% |
| Total MSW WTE | 756,000 | | 64.9% |
| Total Honolulu Landfilling Tons | 113,000 | | 9.7% |
| **Total Honolulu MSW Generation** | | **1,116,000** | |
| **Per capita MSW Generation** | **1.30** | | |

[8] The methodology used was as follows: We estimate that the typical ratio of diverted Paper to metal/glass/plastic (MGP) is approximately 60/40. We used this ratio in combination with actual tonnages of non-ferrous diverted materials in Honolulu to arrive at an estimate of ferrous metals diverted.

### *Maui*

The Maui County Recycling Section of the Department of Public Works and Environmental Management (DPWEM) provided Maui's waste disposal numbers. Biosolids were removed from MSW disposal tonnages as per the method developed and used for Nevada in this study. Maui's recycling tons were adjusted for biosolids as shown in Table 10.

**Table 10 Derived Tonnages of MSW Recycled in Maui**

| | | Tons |
|---|---|---|
| **Recycling (unadjusted)** | | **73,000** |
| | less biosolids | 24,000 |
| | **MSW Recycled** | **49,000** |

**Table 11 Derived Tonnages of MSW Disposed in Maui**

| | | Tons |
|---|---|---|
| **Disposal (unadjusted)** | | **163,000** |
| | less biosolids | 36,000 |
| | **MSW landfilling** | **127,000** |

Finally, Table 12 shows a summary of MSW tonnages generated and disposed in Maui.

**Table 12 Derived Tonnages of Waste Generation and Disposition in Maui**

| | Tons | Percent |
|---|---|---|
| **Total MSW Landfilled** | **127,000** | **72.2%** |
| **Total Maui Recycling Tons** | **49,000** | **27.8%** |
| **Total Maui MSW Generation** | **176,000** | |
| **Per capita MSW Generation** | **1.26** | |

### *Hawaii County*

The Recycling Section of the County of Hawaii Dept. of Environmental Management (DEM) provided Hawaii County data. They made available to Columbia their FY01-02 to FY05-06 Solid Waste Disposal Summary. An additional landfilling characterization report was provided by the same department [20]. This quantifies landfilling tonnages and details recycling tonnages as well. Biosolids were accounted for as per the method introduced in the Nevada section of this report, and C&D tons disposed were estimated using the CIWMB characterization report. The results are shown in Table 14.

Household hazardous waste and auto scrap were both included in Hawaii County's reported recycling tons. They had to be removed from MSW calculations. This step is shown in Table 13.

**Table 13 Derived Tonnages of MSW Recycled in Hawaii (County)**

| | | |
|---|---|---|
| **Recycling (unadjusted)** | | **78,000** |
| | less household hazardous waste | Negligible |
| | less auto scrap | 13,000 |
| | **MSW Recycled** | **64,000** |

**Table 14 Derived Tonnages of MSW Disposal in Hawaii (County)**

| | | **Tons** |
|---|---|---|
| **Disposal (unadjusted landfilling)** | | **223,000** |
| | less biosolids | 2,000 |
| | less C&D | 48,000 |
| | **MSW disposal** | **172,000** |

Totals and rates for Hawaii County are shown in Table 15.

**Table 15 Derived Tonnages of Waste Generation and Disposition in Hawaii (County)**

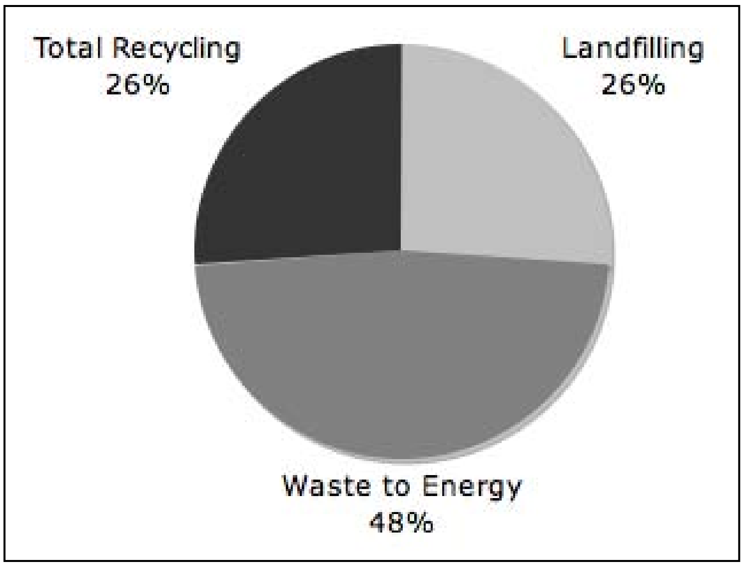
| | **Tons** | **Percent** |
|---|---|---|
| Total MSW Landfilled | **172,000** | **72.9%** |
| Total Hawaii (County) Recycling Tons | **64,000** | **27.1%** |
| **Total Hawaii (County) MSW Generation** | **236,000** | |
| **Per Capita MSW Generation** | **1.41** | |

With 95 percent of Hawaii's population accounted for, the results from the islands were combined to produce a set of tonnages and rates for the state. The results are shown in Table 16.

**Table 16 Derived Tonnages of Waste Generation and Disposition in Hawaii (Overall State)**

| | Tons | Percent |
|---|---|---|
| Total MSW Recycling Tons | 410,000 | **24.9%** |
| Total MSW WTE | 756,000 | **45.8%** |
| Total Hawaii Landfilled Tons | 483,000 | **29.8%** |
| **Total Hawaii MSW Generation** | **1,650,000** | |
| **Per capita MSW Generation** | **1.39** | |

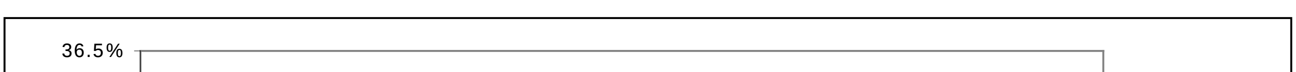
**Figure 7 Hawaii (Overall State) MSW Management**




## Effect of Arizona Data on Overall Region 9 Management

Though Arizona was not able to participate in this study (there was staff turnover during the active research phase), a simple sensitivity analysis shows the possible effects their data would have on overall Region 9 numbers. As shown in Figure 8, Arizona would need to be recycling a minimum of 16 percent of their MSW in order to maintain a Region 9 recycling rate of 35%. Arizona's likely recycling rate of around 20 percent [9] would maintain a Region 9 overall rate of greater than 35.5 percent, easily surpassing the national target.

**Figure 8 Arizona's Potential Effect on Overall Region 9 Recycling Rates**



## Overall Region 9 MSW Management Totals & Rates

Table 17 shows the results of the three states of Region 9 that were examined in this study (California, Nevada, and Hawaii).

**Table 17 Overall Region 9 (Examined) MSW Management Totals & Rates**

| | Tons | Percent |
|---|---|---|
| Total Region 9 Recycling Tons | 20,438,000 | **37.9%** |
| Total MSW WTE Tons | 1,347,000 | **2.5%** |
| Total Region 9 Landfilling Tons | 32,135,000 | **59.6%** |
| **Total Region 9 MSW Generation** | **53,920,000** | |
| **Per capita MSW Generation** | **1.39** | |

## Opportunities for Increased Diversion in Region 9

In this study, we were mostly confined to bulk metal-glass-paper-plastics (MGPP) data, with little information on the recycled tons of each material. Without detailed data on specific types of materials being recycled it is difficult to know the tonnages of individual materials that are recycled in Region 9. However, when certain jurisdictions perform waste characterization studies – and when these are accompanied by high quality recycling data – we are able to open a window into opportunities for higher diversion. California and Honolulu are jurisdictions with recent enough characterization studies that allow us to look more closely at recycling opportunities.

We start with Honolulu, which, as mentioned, accounts for over 70 percent of Hawaii's population and is thus an important barometer of statewide recycling activities. An analysis of the characterization study in combination with county-reported recycling data showed that there are several key materials that can be targeted for increased diversion.

Only 2.9 percent of plastics are currently captured for recycling in Honolulu. The next-lowest examined commodity is paper, with a 19 percent capture rate. If plastics were to be brought up to the level of paper recycling, the overall Honolulu diversion rate would jump from 25.5 percent to 27.4 percent, an increase of 1.9 percent. Paper is a similar "low-hanging fruit" – if Honolulu were able to increase the diversion of paper from the current level of 19 percent to 25 percent (a modest goal), the overall recycling rate would increase to 27.7 percent, a 2.2 percent improvement. Table 18 summarizes the above and two other hypothetical scenarios for food and yard wastes.

**Table 18 Material-Specific Recycling Tonnages in Honolulu**

| **Honolulu Tons** | **Food** | **Yard** | **Paper** | **Plastic** |
|---|---|---|---|---|
| Disposed | 120,000 | 82,000 | 345,000 | 132,000 |
| Recycled | 37,000 | 77,000 | 81,000 | 4,000 |
| Total Commodity Generated | 157,000 | 159,000 | 426,000 | 136,000 |
| Commodity Recycling Rate | 23.6% | 48.4% | 19.0% | 2.9% |
| Contribution to Overall Diversion | 12.5% | 25.9% | 27.3% | 1.3% |
| Next Target % | 30% | 55% | 25% | 19.0% |
| Next target tons | 47,000 | 87,000 | 107,000 | 26,000 |
| Tons to next target % | 10,000 | 10,000 | 26,000 | 22,000 |
| Percent overall increase if target attained | 0.9% | 0.9% | 2.2% | 1.9% |
| Overall Recycling Rate if target attained (baseline = 25.5%) | 26.4% | 26.4% | 27.7% | 27.4% |

The picture in California is not as easy to analyze, as detailed commodity-by-commodity recycling information is not available. The only reliable broad-based commodity category we could identify for analysis was organic waste, including food and yard scraps. As Table 19 shows, California recycles 44.8 percent of the organic waste it generates. There is still a great opportunity to divert more organics, as food waste is still disposed of in large quantities.

**Table 19 Diversion of Organics in California**

| | **Organics** |
|---|---|
| Recycled (composting) | 6,979,000 |
| Disposed (landfilling + WTE) | 5,854,000 |
| *Food scraps disposal* | *3,118,000* |
| *Yard waste disposal* | *2,736,000* |
| Total Generated | 12,833,000 |
| **Organics Recycling Rate** | 44.8% |

## Comments and Analysis

The results show that the combination of the three EPA Region 9 States examined in this study are recycling more than 37 percent of their generated MSW, surpassing the 35 percent national MSW recycling goal set by EPA. [21] Though Arizona's tonnages are not included in this analysis, we have calculated that AZ would only have to be recycling roughly 16 percent of its waste at current levels of Region 9 MSW generation to maintain a 35 percent region wide recycling rate. It is reasonable to expect that this minimum is being met, as Phoenix – by far the state's largest city – is currently recycling more than 20 percent of the waste it generates. [22]

Though recycling is a clear success in the region, landfilling remains the predominant means of dealing with MSW in all areas (with the exception of Honolulu, which relies primarily on WTE for all non-diverted waste). Food waste is a prime candidate for increased diversion, as it is present in large volumes and is responsible for much of the negative environmental effects associated with landfilling. States that figure out means for economically and efficiently dealing with this fraction of the waste stream will go a long way towards achieving a successful integrated waste management system.

Finally, one of the most important conclusions we have drawn from this study is that ***there is a tremendous opportunity for convergence between the U.S. EPA and the BioCycle/Columbia studies of waste management in the U.S.*** EPA has excellent data on recycling of MSW, due to strong partnerships with industry organizations. The BioCycle/Columbia team has developed good relations with a robust network of state waste managers who have direct access to MSW generation and disposal data. In addition Columbia has collected data directly from MRFs and compost facilities that are sometimes unwilling to share information with government agencies due to privacy and competitiveness concerns. The strengths of both EPA and Biocycle/Columbia data could be combined to produce a more reliable overall set of MSW management figures. Improved MSW measurement data would support the prioritization and implementation of cost-effective waste reduction, recycling, and compost program development.

The work performed for this project has already had some beneficial results – at least two Region 9 States are now developing stronger MSW reporting initiatives, and the staff in these states is attempting to track data more closely using the EPA definition [23]. This is a hopeful sign – as more states produce better data, the tasks of strategic planning and implementation of sustainable waste management will become considerably easier.

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